What is claimed is:

1.   A method of performing variable-bit-rate communications, the method comprising:

    a)   providing a variable-bit-rate transmitter having a net transfer function;

    b)   generating digital data with the transmitter at a first bit rate, the digital data comprising a sequence of signaling waveforms having a first duty cycle, each signaling waveform having a predetermined shape;

    c)   generating digital data with the transmitter at a second bit rate, the digital data comprising a sequence of signaling waveforms having a second duty cycle, each signaling waveform having the predetermined shape; and

    d)   receiving the digital data generated at the first or the second bit rates with a variable-bit-rate receiver.

2.   The method of claim 1 wherein the step of receiving the digital data comprises matching a transfer function of the variable-bit-rate transmitter to a transfer function of the variable-bit-rate receiver.

3.   The method of claim 1 wherein an amplitude of each signaling waveform is inversely proportional to its duty cycle.

4.   The method of claim 1 further comprising the step of transmitting the digital data generated by the variable-bit-rate transmitter through a free space or a fiber channel to the variable-bit-rate receiver.

5.   The method of claim 1 wherein the sequence of signaling waveforms comprises m-ary pulse position modulation data.

6.   A variable-bit-rate communication system comprising:

    a)   a variable-bit-rate transmitter having a net transfer function, the transmitter generating digital data at a first or a second bit rate, the digital data

4   comprising a sequence of signaling waveforms having a first or a second

5   duty cycle, respectively, wherein each signaling waveform has the same

6   shape; and

7   b)   a variable-bit-rate receiver that receives the digital data generated by the

8   transmitter.

1   7.   The variable-bit-rate communication system of claim 6 wherein the variable-bit-

2   rate receiver includes a receiver filter having a transfer function that is substantially

3   equal to the net transfer function of the transmitter.

1   8.   The variable-bit-rate communication system of claim 6 wherein the variable-bit-

2   rate receiver includes a receiver filter having a transfer function that is substantially

3   equal to a conjugate match of the net transfer function of the transmitter.

1   9.   The variable-bit-rate communication system of claim 6 wherein the variable-bit-

2   rate receiver includes a receiver filter and the variable-bit-rate transmitter includes

3   a transmitter filter, wherein a transfer function of the receiver filter is substantially

4   equal to a transfer function of the transmitter filter.

1   10. The variable-bit-rate communication system of claim 6 wherein the variable-bit-

2   rate receiver includes a receiver filter and the variable-bit-rate transmitter includes

3   a transmitter filter, wherein a transfer function of the receiver filter is substantially

4   equal to a conjugate match of a transfer function of the transmitter filter.

1   11. The variable-bit-rate communication system of claim 7 wherein the variable-bit-

2   rate receiver includes a multi-pass filter or a plurality of cascaded optical filters.

1   12. The variable-bit-rate communication system of claim 6 wherein the variable-bit-

2   rate transmitter is substantially average power limited thereby causing the

3   amplitude of each signaling waveform to be inversely proportional to its duty

4   cycle.

1   13.   The variable-bit-rate communication system of claim 6 further comprising a free

2   space channel or a fiber channel for transmitting the digital data from the variable-

3   bit-rate transmitter to the variable-bit-rate receiver.

1   14.   A variable-bit-rate digital communication system comprising:

2   a)   a variable-bit-rate transmitter having a net transfer function, the transmitter

3   comprising:

4   i)   an optical source that generates digital data at a first or a second bit

5   rate, the digital data comprising a sequence of signaling waveforms

6   having a first or a second duty cycle, respectively, wherein each

7   signaling waveform has the same shape, and

8   ii)   an optical average power limited amplifier that amplifies the

9   sequence of signaling waveforms, each amplified signaling

10   waveform having a maximum power that is determined by an

11   average power limit of the amplifier and its duty cycle;

12 b)   a channel for transmitting the amplified sequence of signaling waveforms;

13   and

14 c)   a variable-bit-rate receiver comprising:

15   i)   a receiver filter that receives the digital data, the receiver filter

16   having a receiver transfer function that is substantially equal to the

17   net transmitter transfer function, thereby spectrally and temporally

18   matching the transmitter to the receiver; and

19   ii)   a detector that detects digital data.

1   15.   The system of claim 14 wherein the channel is a free space or a fiber channel.

1   16.   The system of claim 14 wherein the variable-bit-rate receiver further comprises an

2   optical amplifier that amplifies the digital data.

1   17.   The system of claim 14 wherein the optical average power limited amplifier
2   comprises an Erbium-doped fiber amplifier.

1   18.   The system of claim 14 wherein the receiver filter comprises an optical filter.

1   19.   The system of claim 18 wherein the optical filter comprises a Fabry-Perot,
2   interference, or Bragg grating optical filter.

1   20.   The system of claim 18 wherein the optical filter comprises a symmetric filter, a
2   multi-pass optical filter, or a plurality of cascaded optical filters.

1   21.   The system of claim 20 wherein the multi-pass optical filter comprises a multi-pass
2   Fabry-Perot optical filter.

1   22.   A method of reducing a bit error rate of a digital communication system operating
2   in a noisy channel, the method comprising:

3   a)   providing a variable-bit-rate average power limited transmitter operating in
4   saturation, the transmitter having a net transfer function;

5   b)   generating digital data with the transmitter at a first bit rate, the digital data
6   comprising a sequence of signaling waveforms having a first duty cycle,
7   each signaling waveform having a predetermined shape and having an
8   amplitude that is inversely proportional to its duty cycle;

9   c)   determining that the bit error rate of the digital communication system
10   exceeds a predetermined value;

11   d)   generating digital data with the transmitter at a second bit rate which is
12   lower than the first bit rate, the digital data comprising a sequence of
13   signaling waveforms having a second duty cycle, each signaling waveform
14   having the predetermined shape and having an amplitude that is inversely
15   proportional to its duty cycle, wherein the second duty cycle is less than the

16   first duty cycle thereby increasing the transmitted energy-per-bit and

17   lowering the bit error rate; and

18   e)   receiving the digital data generated at the first and the second bit rates with

19   a variable-bit-rate receiver.

1   23.   The method of claim 22 wherein the step of receiving the digital data comprises

2   spectrally and temporally matching the variable-bit-rate transmitter to the variable-

3   bit-rate receiver.

1   24.   The method of claim 22 further comprising the step of transmitting the digital data

2   generated by the variable-bit-rate transmitter through a free space channel or a

3   fiber channel to the variable-bit-rate receiver.

1   25.   The method of claim 22 wherein the digital data comprises an m-ary pulse position

2   modulation format.

1   26.   A method of optimizing variable-bit-rate communications, the method comprising:

2   a)   providing a variable-bit-rate average power limited transmitter operating in

3   saturation, the transmitter having a net transfer function;

4   b)   generating digital data comprising a sequence of signaling waveforms with

5   the transmitter at a first bit rate, the signaling waveforms at the first bit rate

6   having a first duty cycle and a predetermined shape and having an

7   amplitude that is inversely proportional to its duty cycle;

8   c)   generating digital data comprising a sequence of signaling waveforms with

9   the transmitter at a second bit rate which is lower than the first bit rate, the

10   signaling waveforms at the second bit rate having a second duty cycle and

11   the predetermined shape and having an amplitude that is inversely

12   proportional to its duty cycle, the second duty cycle being less than the first

13   duty cycle; and

14   d)   receiving the digital data generated at the first and the second bit rates with

15   a variable-bit-rate receiver, wherein the receiver comprises a receiver filter

16   having a transfer function that is substantially equal to a conjugate match of

17   the net transfer function of the transmitter thereby spectrally and

18   temporally matching the transmitter to the receiver and receiving the digital

19   data with optimum sensitivity.

1   27.   The method of claim 26 wherein the digital data comprises an m-ary pulse position

2   modulation format.

1   28.   A method of reducing intersymbol interference in a communication system, the

2   method comprising:

3   a)   providing a variable-bit-rate average power limited transmitter operating in

4   saturation, the transmitter having a net transfer function;

5   b)   generating digital data having intersymbol interference with the transmitter

6   at a first bit rate, the digital data comprising a sequence of signaling

7   waveforms having a first duty cycle, each signaling waveform having a

8   predetermined shape and having an amplitude that is inversely proportional

9   to its duty cycle;

10   c)   determining that the intersymbol interference of the digital data exceeds a

11   predetermined value; and

12   d)   generating digital data with the transmitter at a second bit rate which is

13   lower than the first bit rate, the digital data comprising a sequence of

14   signaling waveforms having a second duty cycle, each signaling waveform

15   having the predetermined shape and having an amplitude that is inversely

16   proportional to its duty cycle, wherein the second duty cycle is less than the

17   first duty cycle, thereby increasing pulse spacing and reducing the

18   intersymbol interference.

1 29.   A method of performing optimal communications at one or multiple data rates

2   using spectral filtering, the method comprising:

3   a)   providing a variable-bit-rate average power limited transmitter having a net

4   transfer function;

5   b)   providing a variable-bit-rate receiver comprising a receiver filter having a

6   transfer function that is substantially equal to a conjugate match of the net

7   transfer function of the transmitter;

8   c)   generating digital data with the transmitter at a first bit rate, the digital data

9   comprising a sequence of signaling waveforms having a first duty cycle,

10   each signaling waveform having a predetermined shape; and

11   d)   receiving the digital data with the receiver.

1 30.   The method of claim 29 further comprising the step of generating digital data with

2   the transmitter at a second bit rate, the digital data comprising a sequence of

3   signaling waveforms having a second duty cycle, each signaling waveform having

4   the predetermined shape.

1 31.   An optical filter that generates double pass Fabry-Perot transmission

2   characteristics, the filter comprising:

3   a)   a single-polarization fiber isolator that generates a polarized optical signal

4   beam having a single polarization;

5   b)   a polarization beam splitter in optical communication with the polarization

6   fiber isolator, the polarization beam splitter passing the polarized optical

7   signal beam through one port;

8   c)   a Fabry-Perot filter in optical communication with the polarized optical

9   signal beam; and

10   d)   a Faraday mirror in optical communication with the Fabry-Perot filter, the

11   Faraday mirror modifying the polarization of the signal beam and reflecting

12   the signal beam back to the Fabry-Perot filter and the polarization beam

13   splitter, wherein

14   the beam splitter directs the signal beam having the modified polarization

15   through a second port, thereby generating the double pass Fabry-Perot

16   transfer function.

1   32.   A method of optimizing a modulator extinction ratio in a communication system,

2   the method comprising:

3   a)   providing a variable-bit-rate average power limited transmitter operating in

4   saturation;

5   b)   measuring a peak output power of the transmitter; and

6   c)   adjusting a modulator control of the transmitter to maximize the peak

7   transmitter output power, thereby minimizing the extinction ratio.